

5.0 ANALYSIS OF RESTORATION ALTERNATIVES

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5.0 Analysis of Restoration Alternatives

This draft RP/EA includes a suite of proposed restoration actions, which, in combination with the emergency response and restoration activities,²⁴ provides appropriate types and quantities of restoration actions necessary to address the natural resource injuries resulting from the Incident. The following discussion explains the proposed projects and outlines the Trustees' explanation of why the proposed restoration package is necessary and sufficient compensation for the natural resource injuries that resulted from the Incident.

The following discussion is divided into three sections: 1) Evaluation of the No-Action Alternative; 2) Discussion of the Proposed Preferred Alternative; and 3) Discussion of the Non-Preferred Alternatives. For the second section, each of the preferred projects is described in terms of the primary category of injury that will be addressed, along with the expected collateral benefits. As discussed elsewhere, this Preferred Alternative is preliminary and subject to public review and comment. **The public may suggest revisions to the proposed projects, propose alternative projects, or request clarifications, further explanation, or additional information. The Trustees will address substantive comments before issuing the final restoration plan.**

5.1 Evaluation of the No-Action/Natural Recovery Alternative

The NEPA requires the Trustees to consider a "no-action" alternative and the Oil Pollution Act regulations require consideration of an equivalent natural recovery option (15 CFR § 990.53). Under this alternative, the Trustees would take no direct action to restore injured natural resources or compensate for lost services pending environmental recovery. Instead, the Trustees would rely on natural processes for recovery of the injured natural resources. While natural recovery would occur over varying time scales for the injured resources, the interim losses suffered would not be compensated under the no-action alternative.

The principal advantages of the no-action approach are the ease of implementation and the absence of monetary costs because natural processes rather than humans determine the trajectory of recovery. This approach, more than any other, recognizes the tremendous capacity of ecosystems to self-heal.

After evaluation of the environmental tradeoffs, the Trustees selected natural recovery for a limited number of the injuries. For example, the Trustees considered options for restoration of

²⁴ Trustees must take into consideration the benefits of the response and emergency restoration actions when determining the need for, and amount of, longer-term restoration. Those efforts taken to mitigate the impacts from response or as part of the permit process are not to be credited as restoration under the NRDA process. Certain actions taken after emergency restoration, but before the release of this draft RP/EA, are proposed as restoration because those actions are not being credited as mitigation actions.

contaminated groundwater resources in lower Hanna Creek. The Trustees discussed options and decided the chance of success of any option other than natural recovery was low to moderate and the environmental injury would be high. The option discussed included building a road out to the ridge separating Hanna and Whatcom creeks in order to put in recovery wells. This option would have resulted in removal of the vegetation and other collateral impacts from the road construction. Because of the potential adverse effects and concerns about feasibility, the Trustees decided that natural recovery was the best alternative.²⁵

The Oil Pollution Act, however, clearly establishes Trustee responsibility to seek compensation for interim losses pending recovery of the natural resources (15 CFR § 990.53 (3)(c)(1)). This responsibility cannot be addressed through a no-action alternative. While the Trustees have determined that natural recovery is appropriate as primary restoration for some of the injuries, the "no-action" alternative as the sole alternative is rejected for compensatory restoration. Losses were and continue to be suffered during the period of recovery from this Incident and technically feasible, cost-effective alternatives exist to compensate for these losses, which are discussed in the next section.

5.2 Proposed Preferred Alternatives

The Trustees propose the following suite of restoration projects to address the ecological and human-use losses from the Incident. The list of proposed Preferred Alternatives includes completion of certain restoration projects already implemented or underway as a part of emergency restoration, as well as additional projects proposed for future implementation. The Trustees base this selection on the injury information summarized in Chapter 3 and the restoration evaluation criteria outlined in Section 4.2. The Preferred Alternative includes four categories of projects:

1. **Land Acquisition and Park Enhancements**—This element of the proposed plan includes the transfer from the Company to the City of Bellingham of a 9.5-acre parcel along the Creek and Woburn Street that was proposed for multiple-occupancy housing. Transferring this parcel to the City of Bellingham's ownership will protect it from being commercially developed and allow it to return to its natural state. The site will also increase public access to park trail systems and other outdoor recreation uses. An access road, parking lot, and restroom facility will be constructed on a small portion of the site. Leaving the site undeveloped, except for the proposed improvements listed above, will enhance fish and wildlife habitat, prevent pollution that would further degrade the Creek and environment, and avoid future increases to stormwater runoff within the Whatcom Creek watershed.

The proposed plan also involves the transfer from the Company to the City of Bellingham of a 4-acre property along Whatcom Creek, near the mouth of Cemetery Creek and adjacent to

²⁵ The last sample to exceed water quality standards was taken July 6, 2000 (AR #15).

an industrial park. This property will provide a buffer area that will enhance the natural setting and recreational experiences on the pending trail system. The buffer will allow for a greater setback from the Creek for recreational trails and vegetative plantings, and provide corridors for wildlife habitat.

Other park enhancements include giving the Company restoration credit for construction of a recreational trail bridge over Fever Creek and trail replacement and improvements within the Park; public-use improvements as part of the Valencia Street Bridge reconstruction; and park improvements to the property above Woburn Street. (See Section 5.2.1 for more information.)

2. **Fish Habitat Projects**—Continuation of the construction of in-channel riffle-pool habitat, introduction of woody debris, backwatering of fish passage barriers; reconstruction of Hanna Creek; construction of off-channel salmon habitat at the Salmon Park project near Racine Street; and construction of pools, wetlands and salmon rearing habitat on Cemetery Creek. (See Section 5.2.2 for more information.)
3. **Soil Stabilization and Revegetation Projects**—Continuation of soil stabilization, revegetation, invasive-species control actions, and removal of hazardous trees and limbs. (See Section 5.2.3 for more information.)
4. **Long-term Monitoring and Maintenance**—Establishment of a dedicated fund to support monitoring and maintenance of the emergency and long-term restoration projects and to conduct periodic maintenance of the burned parklands (e.g., removal of hazardous snags). The City of Bellingham, pursuant to an agreement among the Trustees, would administer the fund. (See Section 5.2.4 for more information.)

As noted previously, a number of the proposed activities have collateral benefits. For example, the proposed property acquisitions and salmonid projects will benefit water quality by preventing development and the associated degradation of water quality from construction and non-point runoff from vehicles and storm drains. The land preservation and vegetation projects will also provide shade to the stream, provide sedimentation filtration, and increase stormwater retention.

5.2.1 Preferred Alternative: Land Acquisition and Park Enhancements Project Description

The Trustees propose the transfer from the Company to the City of Bellingham of lands for use as parklands and for park improvements (Figures 33, 34, 39, 40).²⁶ The primary purpose of these projects is to compensate for recreational losses resulting from the Incident. As the plantings mature and other improvements are made, the Trustees expect that the parcels will be a seamless addition to the Whatcom Falls Park and Trail System. The Trustees expect that these projects will also generate benefits for water and sediment quality, fish and other stream biota, wildlife,

²⁶ Restrictive covenants will be required to ensure the properties are kept in perpetuity as restoration sites.

aesthetics, and provide opportunities for future restoration projects. Specifically, the Trustees propose the following actions:

- Accept the transfer of a 9.5-acre property along the Creek off Woburn Street (Figure 40).
- Build recreational improvements. The majority of the 9.5-acre site would remain undeveloped, but an access road, an approximately 20-stall parking lot, and a restroom facility with two men's and two women's stalls, would be built near an existing access road off Woburn Street (AR #23, 110).
- Accept the transfer of a 4-acre property along Whatcom Creek near the confluence with Cemetery Creek (Figure 39). The primary purpose of this acquisition is to make the land available for long-term fish, wildlife, and riparian habitat restoration projects by the City of Bellingham.²⁷ Only minimal park improvements are planned for this parcel as part of this restoration plan, but the acquisition of the land will allow for a greater setback from the Creek for recreational trails and provide a continuous wildlife corridor and buffer the stream from development-related impacts.
- Give restoration credit to the Company for reconstruction and improvement to trails and overlooks within the Park areas (completed as part of emergency restoration but will be monitored and maintained by the long-term monitoring and maintenance plan being proposed under this RP/EA).
- Give restoration credit to the Company for the construction of a trail bridge over Fever Creek (Figure 35) and for improvements during reconstruction of the Valencia Street Bridge (Figure 36) to provide continuity with the Whatcom Creek Trail system and provide space for bike/pedestrian lanes (completed as part of emergency restoration but will be monitored and maintained by the long-term monitoring and maintenance plan being proposed under this RP/EA).

Scaling Approach and Justification

One of the significant injuries documented by the Trustees was closure and destruction of park resources and properties. The property acquisition, combined with park improvements and recreational trails, is expected to compensate for these injuries and loss of services by increasing park visitation and trail usage opportunities without increasing congestion and user density. The Trustees prefer these projects because they directly compensate for recreational lost use of parklands and help compensate for biological injuries to the riparian and forest habitats. The Trustees considered land parcels outside the Whatcom Creek watershed but decided that on-site restoration would benefit the habitats and park users most directly affected by the Incident. The

²⁷ The City of Bellingham has indicated a preference for land acquisition and protection, in part to provide a location for future restoration opportunities.

proposed acquisitions are adjacent to the Creek and existing public lands, and are expected to add significantly to the connectivity of wildlife habitat and greenways. In addition to increasing total park acreage, the improvement of trails, construction of overlooks, and acquisition of properties adjacent to proposed trail segments will further enhance park access and usage.

The Oil Pollution Act regulations specify that restoration efforts should attempt to match directly the same type and quality of services lost as a result of the Incident to those generated by the restoration effort (15 CFR § 990.53 (3)(c)(2)).²⁸ The Trustees believe that the acquired lands, being adjacent to the existing park, would provide the same type of services. In order to ensure that the public is not under-compensated, an equivalency must be established between the quantity of services provided by the acquired lands and an estimate of the loss of park use resulting from the Incident.

The public clearly lost access to Whatcom Falls Park, but because no fees are charged to enter the park and there are many access points to the park, there was little data on record which the Trustees could draw upon to quantify that loss. In the absence of detailed information regarding pre-Incident park use, the Trustees relied upon available data and assumptions and inferences that can be drawn from the data. The City of Bellingham Parks Department's preliminary estimate²⁹ is that approximately 186,000 visits occur each year in the Park, with about half of those visits (96,000) during the summer (June through September) (AR #2). The chronology of the park area closures and re-openings is complicated, but, to be conservative, the Trustees assumed that the entire park was closed for the full summer period after the Incident resulting in 96,000 lost user-days.

Relying upon a simple count of lost user-days does not address the nature and quality of the user's experience, and could lead to inaccurate assumptions about the scale and type of restoration actions that would be adequate to compensate for the losses. Other important factors, such as location and use patterns, must be taken into account in addition to the actual number of days lost to accurately account for the actual injury. To use an extreme example, offering a one-day pass for 96,000 local residents to visit a remote park on the same day would clearly generate 96,000 user-days, but would be unlikely to be viewed by the public as adequate compensation for lost use of Whatcom Park. Factors such as location, distance, accessibility, amenities, physical setting, user density and the like must be taken into account in judging the comparability of park use opportunities offered in compensation for lost user-days. Likewise, the

²⁸ OPA regulations state "To the extent practicable, when evaluating compensatory restoration actions, Trustees must consider compensatory restoration actions that provide services of the same type and quality, and of comparable value as those injured. If, in the judgment of the Trustees, compensatory actions of the same type and quality and comparable value cannot provide a reasonable range of alternatives, Trustees should identify actions that provide natural resources and services of comparable type and quality as those provided by the injured natural resources."

²⁹ As noted in the Preassessment Data Report, this preliminary estimate is conservative and may be a low-end estimate of direct use.

Trustees assume that an important aspect of park use experience is the user's knowledge that the park property belongs to the public and will remain permanently available for continued open access use by the public in the future. The Trustees assume it is factors such as these, and other intangibles, that determine park user satisfaction, and that those factors should weigh as heavily in the scaling of compensatory restoration for lost park user-days as numerical calculations of user-days lost and gained.

The entire park is approximately 240 acres with many areas that are much more difficult to access than the proposed acquisition. Although usage is not uniform throughout the park, it is reasonable to assume that the overall quality of a park visit results from both access paths and undeveloped open space. This would indicate that an acre of parkland supports 775 visits per year. The proposed acquisition is 13.5 acres, with similar access and open-space design as the existing parkland.

Given current and future demands for open-space recreation within easy access of the City Center, it is assumed that the additional parkland will be used in a similar manner and frequency as the pre-Incident parkland. Based on the average utilization rates of the Park, the expansion of the Park would result in an additional 10,463 visits per year without increasing congestion. The new parkland may in fact generate more use because of its easy access and stream frontage of the proposed properties, as well as the proposed trail and visitor facilities. At this rate, the acquired property would compensate for the estimated loss in visitation in approximately nine years and then provide benefits in perpetuity. By increasing the size and integrity (i.e., continuity) of parklands, the property acquisitions also compensate for interim losses associated with passive lost uses of the Park and Creek resources.

In addition to the primary goal of compensating the public for recreational losses, the Trustees anticipate that significant ecological benefits will accrue from the acquisition and preservation of the proposed properties. The Creek flows through an urbanized residential and commercial area with an extensive urban road system and expanses of impervious parking lots and business complexes that limit groundwater recharge and contribute oil, gas, and other waste runoff to the stream. In some locations, only a narrow protective buffer separates the stream from surrounding uses, and below the existing Park there are few undeveloped parcels. Current land-use regulations affecting new development require wider streamside buffers, but they are often not sufficient to fully protect the stream from urban runoff and other non-point pollution. Because the stream is channelized throughout much of its length and the adjacent property is privately owned, there is little opportunity for habitat development projects. Vegetated floodplain areas provide valuable habitat for many fish, bird, and mammal species and can serve as connecting corridors that enable wildlife to move safely from one habitat to another. They are productive areas and help reduce erosion, contain non-point source runoff, and recycle nutrients.

Acceptance of the transfer of the 4-acre property near Cemetery Creek will create a 150- to 200-foot-wide streamside buffer, in which commercial development is prohibited, along 1,200 feet of

the Creek. This will not only preclude the expansion of the commercial business-park development proposed for the property (AR #124) but will also make it available for future habitat restoration projects by the City of Bellingham. Such projects could include revegetation with a diverse floodplain forest mixture of trees and shrubs, as well as other floodplain and off-channel restoration projects. This acquisition also provides a more extensive buffer along the proposed greenbelt trail system to enhance the experience of public use.

Acceptance of the transfer of the 9.5-acre property near Woburn Street will preserve the property for restoration, as opposed to a residential development (AR #125),³⁰ thus providing potential for future riparian habitat restoration projects by the City of Bellingham on the floodplain adjacent to the Creek. The property acquisition actions will preserve areas important for groundwater infiltration and not increase other adverse impacts associated with site development, such as stormwater runoff to the Creek, turbidity, siltation, and non-point pollution.

The Trustees believe that a more intensive data collection and analysis effort to determine the losses and benefits would be unreasonable. The Trustees believe that the project, in conjunction with the other restoration actions and emergency restoration projects, is sufficient compensation for recreational and ecological losses to the Park resulting from the Incident.

Restoration Objectives

The Incident resulted in the injury and/or interim loss of parklands and riparian and wildlife habitats along the Creek. The objective of this restoration project is to compensate for those losses. This proposed acquisition would provide functions and services similar to those that were lost, resulting in compensatory restoration of those resources. Furthermore, the acquisition ensures prevention of commercial development, which will benefit birds, fish, and other animals in the watershed.

Probability of Success

The Trustees expect to meet the restoration objectives discussed above because of the characteristics chosen for the projects. The proposed parcels are similar to the adjacent parklands, and, as the plantings mature and other improvements are completed, the recreational and habitat services provided should be comparable with those that were lost. Since the parcels are adjacent to the stream and the existing park, public use is expected to be high. The performance criteria and monitoring will help ensure the success of the projects and allow for adjustments if necessary.

³⁰ The Whatcom Creek property has been proposed for a multi-unit housing development. Thus, acquisition of this property represents the further benefit of making its resources available to the public and preventing these resources from being degraded through potential future development.

Performance Criteria and Monitoring

The acquired lands will be surveyed prior to conveyance to City ownership. The Company will develop plans for all Park improvements included within the scope of this draft RP/EA, subject to review and approval by the City of Bellingham and in accordance with all necessary permits. All construction activities will be monitored by the Trustees and permitting agencies to ensure that the work is implemented appropriately and in accordance with permits. Restrictive covenants will be required to ensure the properties are kept in perpetuity as restoration sites. Projects such as the bridge and trail construction will be documented using video and still photography.

Benefits and Environmental Impacts

Acquisition of the property is not anticipated to have any deleterious environmental or socioeconomic impacts. Potential impacts from the project are summarized here.

- **Erosion**—Certain construction activities that the Trustees are considering would cause some short-term construction-related environmental impacts. The Trustees would minimize these impacts through early coordination with the federal, state and city regulatory agencies and by direct oversight of the project to ensure implementation of construction site erosion and chemical control BMPs.
- **Endangered Species**—No adverse impacts are expected for endangered species. No endangered plants are in the project area. Endangered salmon will be protected through erosion control measures and other permit requirements, and will benefit from the shade and habitat provided by a healthy riparian zone.
- **Wildlife Impacts**—No adverse impacts are expected for wildlife. Overall, wildlife are expected to benefit from the land acquisition, but wildlife activity may be temporarily disturbed during the construction of the restroom and parking lot structures. If sensitive wildlife species are found during the project (e.g., nesting birds), the work may be modified or stopped to minimize impacts to wildlife.
- **Archaeology**—No known archaeological sites are on the lands proposed for acquisition. Overall, any archaeological resources on the proposed sites would benefit from the proposed acquisition, as commercial and residential development will be precluded. There is, however, a potential that construction work may unearth a site. The Trustees are in consultation with the Tribes and the Office of Archaeology and Historic Preservation to outline steps that would be taken to ensure that any sites discovered would remain undisturbed by the proposed actions (AR #139, 140).

Evaluation

The Trustees' policy is to look first at on-site and in-kind restoration options. The proposed activities meet this goal by providing recreational and habitat benefits of the same types that

were lost and at the location where the losses occurred. The proposed projects are consistent with the City's long-term park improvement and trail system plans (AR #8, 9, 19). The Trustees believe that the projects will, over time and in conjunction with the vegetation and fish habitat projects, compensate for human and ecological losses resulting from the Incident.

5.2.2 Preferred Alternative: Fish Habitat Projects

Project Description

One of the major impacts documented by the Trustees was injury to anadromous and resident salmonids, fish, and other aquatic resources. Emergency instream restoration actions were undertaken in conjunction with sediment remediation and resulted in fish habitat enhancements in Whatcom and Hanna creeks.³¹ Pools were increased in number, size and depth (Figure 26). The Creek channel was modified in some areas to provide more spawning habitat (pool/bar enhancement). Large woody debris was added (Figures 28, 29). These actions improved the quality of the existing instream habitat, increased the quantity of some habitats (e.g., pools), and added some channel structure. The habitat improvements associated with the sediment remediation effort will result in a potential increase in survival of the progeny of returning adults and juveniles that may have been in Whatcom Creek tributaries during the Incident.

The Trustees propose two long-term habitat rehabilitation and enhancement projects, Salmon Park and Cemetery Creek, as compensatory restoration for injuries to salmonids, other fish, amphibians, aquatic invertebrates, and freshwater and riparian habitats that resulted from the Incident (AR #118). These projects are also expected to generate benefits for water quality, recreation, vegetation, and wildlife, and will significantly build upon the emergency restoration projects already completed. The Trustees considered a number of restoration alternatives for fisheries impacts and several alternative designs for the Salmon Park and Cemetery Creek projects (AR #119-122), and believe the proposed projects will provide the most direct and beneficial compensation with the least potential for adverse impacts. While the Trustees are interested in prompt implementation of restoration actions for the Creek, there is also a recognition that many salmonid restoration efforts elsewhere have resulted in mixed and sometimes adverse effects (AR #127). Therefore, the Trustees have attempted to balance the desire for rapid restoration with appropriate caution.

More detail and draft plans can be found in Appendix 9.5. If these alternatives are selected, then a final detailed design plan and alternatives analysis will be prepared and attached to the final RP/EA. Specifically, the Trustees propose the following actions:

³¹ These actions are not formally part of this draft RP/EA, but are described here to explain that a significant amount of restoration work has already been conducted as emergency restoration. The amount of long-term restoration necessary depends, in part, on the success of the response and emergency restoration actions. To the extent that response and emergency restoration actions result in more rapid recovery of natural resources, the need for long-term restoration is reduced.

Salmon Park Project—This project involves creation of a backwater channel within a historic meander of the Creek to improve winter refuge habitat for juvenile salmonids (Figure 37). The project site is in the Salmon Park area just north of the Creek and east of Racine Street. The City of Bellingham already owns the project land.

Cemetery Creek Project—This project involves creation of salmonid rearing ponds and habitat enhancements in Cemetery Creek upstream of its confluence with Whatcom Creek (Figure 38). The project site is along the south bank of the Creek and north of Fraser Road. The City of Bellingham already owns the project land.

Scaling Approach and Justification

The primary purpose of these projects is to compensate for injuries to salmonids due to the Incident. The Salmon Park and Cemetery Creek projects will directly address two known limiting factors: 1) the limited availability of cool water refugia during the summer months, and 2) the limited availability of off-channel habitat that is normally provided when streams are allowed to meander onto the floodplain and form secondary channels. The complexity of stream channel margins can be an important factor influencing early rearing success, and ecologically healthy streams contain complex margins that include backwaters and secondary channels (AR #123, 134, 136). Juvenile fish use different habitats seasonally, and periods of high runoff and low food availability during winter force them to seek overwintering locations adjacent to, but not in, stream main stems, making floodplain channels extremely important to juvenile survival. Floodplains serve an important purpose in the health of streams (AR #123). During over-bank flows, the stream can capture the organic matter stored on the floodplain and deliver it to the main channel, enhancing trophic and food web complexity by increasing the quantity and diversity of detrital input to the stream. Hydrological connectivity also enhances water quality by trapping and retaining sediment, and recharges local groundwater, contributing to the maintenance of cooler inflow. Water temperature is related to the subsoil environment, and deep channels that interact with cool groundwater can provide important thermal refugia during summer periods of high water temperatures.

The Trustees prefer these projects because they directly compensate for fish habitat losses and help compensate for biological injuries to the riparian and forest habitats. Additionally, the construction of these restoration projects may reduce future losses to the stream due to encroaching urban activities that might otherwise occur in these areas.

The Trustees' priority in selecting these restoration options as preferred alternatives was to identify projects that provide services of comparable type, quality, and value as those provided by the lost ecological services. The Trustees believe that the increased freshwater rearing habitat provided by the Salmon Park and Cemetery Creek habitat creation and enhancement projects will provide services of the same types as those lost as a result of the Incident. These projects are in the Whatcom Creek watershed and are within the Incident zone (Figure 32). The project sites currently provide valuable but limited benefits to the same species of fish, invertebrates, and

amphibians that were affected by the Incident. The proposed enhancements will substantially increase the size and ecological value of the habitats for fish, invertebrates, and amphibians. Specifically, the proposed improvements are expected to provide:

- Increased salmonid rearing habitat during summer months by creating thermal refuge habitat;
- Increased salmonid rearing habitat during winter months by creating backwater habitats during winter rainfall events; and
- Improved habitat complexity for all life stages of salmonids, resident fish, and amphibians.

In order to determine whether the size and benefits of the proposed projects would be sufficient compensation, the Trustees evaluated the results of the preliminary studies, reviewed the applicable restoration ecology literature to help quantify the potential benefits of the response and emergency restoration actions, and considered the estimates of the fish kill from the Incident and the results of the post-spill fish recovery monitoring surveys (AR #87). The Trustees conducted a preliminary Habitat Equivalency Analysis (HEA) using simplifying assumptions to estimate the magnitude of restoration required to compensate for injuries resulting from the Incident.

HEA is a methodology used to determine scale of restoration projects for resources injured by oil and chemical releases (AR #81). The principal concept underlying the method is that the public can be compensated for past losses of habitat resources through habitat replacement projects providing additional resources of the same type. Natural Resource Trustees have employed HEA for groundings, spills, and hazardous waste sites. Habitats involved in these analyses include seagrasses, coral reefs, tidal wetlands, salmon streams, and estuarine soft-bottom sediments. In this Incident, the Trustees used HEA to evaluate the adequacy of the Cemetery Creek and Salmon Park projects for injuries to fish habitat.

Natural resource damage claims have three basic components: 1) the cost of restoring the injured resources to baseline, or “primary restoration,” 2) compensation for the interim loss of resources from the time of injury until the resources recover to baseline “compensatory restoration,” *plus* 3) the reasonable costs of performing the damage assessment. To ensure full compensation for interim losses, the Trustees determine the scale of the proposed compensatory restoration actions for which the gains provided by the actions equal the losses due to the injury. The process of scaling a project involves adjusting the size of a restoration action to ensure that the present discounted value of project gains equals the present discounted value of interim losses.

HEA is an example of the service-to-service approach to scaling. The implicit assumption of HEA is that the public is willing to accept a one-to-one trade-off between a unit of lost habitat services and a unit of restoration project services (i.e., the public equally values a unit of services at the injury site and the restoration site). HEA does not necessarily assume a one-to-one trade-off in the resources themselves, but instead in the services they provide.

HEA takes into consideration the amount and quality of habitat lost or restored and the time frame of the losses and gains to determine the scale of restoration action needed to compensate for the losses. In this case, the Trustees assume that the proposed restoration project will generate habitat services of the same type and quality and of comparable value per acre as were lost due to the injury. Consequently, the HEA need only address the size of project (in acres) and the years the project will produce the expected benefits in order to determine the adequacy of compensation.

Injury Assumptions—Gasoline and the resulting fire killed much of the aquatic biota in lower Whatcom Creek. As a first-order assumption, the Trustees estimated that 3 miles of stream habitat were completely destroyed. The average width of the Creek is 15 feet. The total aquatic injury was therefore 237,600 square feet, or 5.45 acres of lost stream habitat. The Trustees estimated that the stream provided no resource services for one year, and that recovery of the aquatic habitat will take 5 years. The recovery of the stream was assumed to be linear (i.e., that the stream will recover at a constant rate per year until full recovery is reached).

Proposed Projects Benefit Assumptions—The Trustees have identified a feasible restoration action for compensation: creation of off-channel salmon habitat at a nearby site. The project is expected to restore the same type and quality of resources and services per acre as did Whatcom Creek before the Incident. The Trustees assumed that the project would be built in the present year (2002), and that it would take 20 years to reach full maturity.³² The rate of recovery was assumed to be linear. Because of the proximity and similarity of injured and created habitats, the Trustees assumed that after 20 years, the created habitat would provide the same amount of environmental services per acre as the injured stream habitat. (In other words, the mature created habitat would provide 100% of the services per acre provided by the pre-spill stream habitat.) Based on the preliminary conceptual drawings of the project, the project is estimated to provide approximately 0.9 acres of aquatic habitat.^{33,34} The Trustees believe that the proposed habitat creation project will last (i.e., will provide the expected environmental services) between 50 and 100 years.³⁵

Discounting—The injured habitats will slowly recover, and the created projects will also take time to reach full function. Because losses and gains are occurring in different years, the Trustees discount the losses and gains so that units reflect what they are worth in the present year, 2002. Past losses are compounded and future losses and gains are discounted at a fixed rate to make

³² The projects will provide ecological services sooner, but full functionality, including regrowth of vegetation and fish utilization, will take time.

³³ Jason Smith, Inter-Fluve, Inc., personal communication.

³⁴ The project site is considerably larger because of enhancement of upland areas. The 0.9 acres refers to the size of the pools and stream channels alone.

³⁵ The project site will be protected in perpetuity, but the aquatic functions provided will change naturally over time as the ponds and stream undergo natural succession.

units from different time periods comparable.³⁶ Discounting also effectively provides a premium for restoration actions taken sooner rather than later.

Taking into consideration the services provided by the affected habitat, the size of the injured and restored habitat, and the time frame of the losses from injuries and gains from restoration, the HEA calculates results in terms of *discounted service acre-years (DSAYs)*. DSAYs thus serve as the common currency for determining the adequacy of compensatory restoration.

Calculation of the Habitat Equivalency—The underlying HEA calculation is to solve the following problem: Will the proposed aquatic habitat project (0.9 acres) provide the same number of DSAYs as those lost? To answer this question the HEA requires two calculations: the calculation of losses from the injuries, and the calculation of gains from the restoration.

The HEA calculation of losses of the approximate 5.45 acres of stream habitat for 5 years, with compounding, equates to 16.69 DSAYs. Table 2 lists the factors employed in this calculation. The assumed linear recovery of the injured area over a five-year period is reflected in the “% Services Lost” column by the loss decreasing from 100% (1.0) to 0% over five years. When the percent services lost are multiplied by the affected area, the result yields the number of service-acres lost per year. Multiplying this result by the discount factor applicable to the year of loss generates a present value, or discounted service-acres lost figure. Adding the discounted losses for all years in which the effects of the injury are experienced yields a total of discounted service acre-years (DSAYs) lost.

³⁶ The discount rate incorporates the standard economic assumptions that people place a greater value on having resources available in the present than on having their availability delayed until the future. (This process is analogous to financial calculations in which, if a dollar is put into the bank today at 3% interest, there will be \$1.03 in one year.) The annual discount rate used in an HEA calculation represents the public’s preference towards having a restoration project in the present year, rather than waiting until next year. The economics literature supports a discount rate of approximately 3%.

Table 2. Calculation of Discounted Service Acre-Years Lost					
A	B	C	D	E	F
Year	% Services Lost (% / 100)	Acres Affected	Service-acres Lost Per Year (B x C)	Discount Factor (@ 3% per annum)	Present Value of Loss (D x E)
1999	1.0	5.45	5.45	1.06	5.78
2000	0.8	5.45	4.36	1.03	4.49
2001	0.6	5.45	3.27	1.00	3.27
2002	0.4	5.45	2.18	0.97	2.12
2003	0.2	5.45	1.09	0.94	1.03
2004	0	5.45	0	0.92	0
				Sum	16.69

The habitat-creation project needs to produce a similar gain in DSAYs to create an equivalency. The discounted calculation of gains in the HEA showed that the 0.90-acre project will generate 15.78 DSAYs if the project functions for 50 years, and up to 20.74 DSAYs if it functions for 100 years. The project will generate the approximate equivalent of the losses (16.84 DSAYs) after 56 years, well within the project's expected lifespan. The HEA calculations that generated these results is shown in Table 4 included as Appendix 9.4.

The calculations of injuries and benefits are preliminary and based on simplified assumptions. The size of the affected area and recovery rates are approximations, and the size of the proposed restoration projects may be modified through public comments and permitting requirements. Based on the first-order assumptions in this analysis, however, the preliminary HEA suggests that the proposed projects will be reasonable compensation for the aquatic impacts in Whatcom Creek. Further studies and analytical approaches to evaluate the losses from the Incident and the likely benefits from the restoration projects were considered, but it was determined that further studies would not provide results in a timely and cost-effective manner. More-comprehensive studies would also delay implementation of the restoration projects. Additionally, because of year-to-year natural variability and the complicated life history of salmon and other injured species in the Whatcom Creek watershed, it was uncertain whether the outcome of studies conducted in any one year would provide information that would support a more accurate scaling calculation.

Restoration Objectives

The goals for restoration in Salmon Park and Cemetery Creek are to create new aquatic habitats and enhance and restore existing salmonid habitat to a level greater than that which existed prior the Incident. Due to the fact that stream temperature has been identified as one of the more important environmental factors affecting salmonid habitat in the Creek, the restoration has focused primarily on providing cool-water refuge and rearing habitat during the summer months.

The Salmon Park site has been identified by the City of Bellingham as a location in which winter rearing habitat and high-flow refuge could be created through reconnection and construction of backwater rearing channels. This will enhance juvenile salmonids' opportunities to escape and survive flood events in the Whatcom Creek watershed. A secondary goal will be to restore the ability of this section of the Creek to meander naturally. In the long term, these conditions will benefit spawning and rearing habitat by creating a larger floodplain area with greater riparian complexity than that which currently exists. The backwater channel will be created by breaching the berm adjacent to the Creek and allowing water to flow back up the channel. At the upstream end of the backwater channel, the berm elevation will be reduced so that flood flows will overtop the berm and eventually erode through it. Thus, creation of the backwater rearing channel in Salmon Park will promote long-term enhancements to spawning and rearing habitat through the progression of natural channel processes.

One of the factors that limits fish production in Cemetery Creek is the availability of rearing habitat, especially due to the warm stream temperatures that occur each summer (AR #15). Therefore, the Trustees have concluded that one of the best ways to increase fish production in the Creek is to increase the amount of cool-water rearing habitat. Temperature studies of the watershed show that Cemetery Creek has cool water available for fish refuge, running from 2° to as much as 5°C colder than Whatcom Creek (AR #15). Therefore, the primary objective of the Cemetery Creek Project is to increase the availability of cool-water summer rearing habitat. A secondary objective is to improve access to these cool-water habitats during all stream flow levels and improve the quality and complexity of the existing habitats. The Cemetery Creek project involves grading incised portions of the stream channel in Cemetery Creek, placing large woody debris to stabilize head cuts, and excavating several deep off-channel pools. This will result in the creation of cool-water rearing habitat and the restoration of 1,200 feet of stream channel, improving rearing habitat and making it more accessible to anadromous fish.

The proposed restoration projects have also been designed to address other limiting factors in Cemetery Creek. These include reduced availability of high-flow refuge and overwintering habitat for juvenile salmon, and the loss of natural habitat-forming processes.³⁷ Specific project objectives have been identified to achieve the overall goal as follows:

- Provide for increased thermal refuge and summer rearing habitat for salmonids by increasing available living space in Cemetery Creek;
- Provide for increased high-flow refuge and winter rearing habitat by creating backwatered off-channel habitats during frequent floods;

³⁷ The dam at the outlet of Lake Whatcom that regulates flows, lack of natural riparian floodplain, and limited natural sources of large woody debris, especially large and rot-resistant cedar trees, combine to preclude the habitat-forming processes that would otherwise naturally occur.

- Improve habitat complexity for all life stages of salmonids in the lower portion of Cemetery Creek (limited to the area within park boundaries and City easements);
- Create instream conditions favorable to the production of fish prey (benthic macroinvertebrates) in Cemetery Creek;
- Remove man-made gravel berms where appropriate to restore geomorphic processes within the confines of Salmon Park;
- Provide enhanced habitat conditions while minimizing impacts to surrounding vegetation and ground surfaces;
- Provide/improve access to available fish habitat by addressing known impediments to fish passage in Cemetery Creek; and
- Provide environmental conditions favorable to the creation and establishment of additional wetland habitats adjacent to the Creek, and the establishment of conifers including Western red cedar.

To achieve these goals and objectives, work will take place within Cemetery Creek and the Salmon Park portion of Whatcom Creek. The proposed project includes a reconstructed channel alignment in place of the current ditched segment of Cemetery Creek and the creation of three on-line cool-water rearing ponds. Ponds will vary between 1 and 6 feet deep. Large woody material will be utilized to create complex channel, pond, and floodplain habitat.

In Salmon Park, a backwater channel will be constructed within a historic meander of the Creek to improve winter high-flow refuge habitat for juvenile salmonids. This channel will be free draining (0.0025 slope) and the extent of inundations will expand and retract as the floodwater stage changes in the creek. The free-draining nature of the channel will prevent fish stranding as flows diminish. Large woody material will be a major cover component for juvenile salmon using this area.

To restore natural river processes within the Salmon Park segment of the Creek, the gravel pushup berms adjacent to the Creek will be removed and the banks modified. Currently, these human-constructed berms are a landscape feature that prevents frequent over-bank flows into the existing historic meander feature. Lowering the berm will facilitate natural channel processes such as planform adjustment and gravel recruitment.

A wetland swale will be constructed where an old Cemetery Creek channel enters Whatcom Creek approximately 600 feet upstream of the existing confluence. The swale will function in a manner similar to the Salmon Park backwater habitat by providing high-flow rearing and refuge habitat during average winter flows. The wetland swale area will be excavated and planted to establish emergent wetland and scrub shrub plant communities. The swale will be free draining to prevent any fish entrapment.

An important component of enhancement work on Cemetery Creek, Cemetery Creek ponds, Salmon Park, and the wetland swale consists of an aggressive re-vegetation plan with a diverse assemblage of native plant species and a variety of plant material types. The installed native plants will initiate the development of productive and diverse riparian plant communities that will help achieve project goals related to salmonid habitat complexity, salmonid thermal refuge, erosion control, and aesthetics. Throughout Salmon Park and Cemetery Creek, cedar plantings will accelerate the establishment of a valuable cedar component that is missing now but occurred historically.

Probability of Success

These projects have a high probability of success. The land is already under public ownership. The projects are expected to be successful because the project sites were once part of the Whatcom Creek and Cemetery Creek watershed, and, although degraded, the project sites already provide some limited fisheries habitats. The projects will address known limiting factors and provide habitat features and functions needed by juvenile salmonids.

The objectives for the rehabilitation have been specifically chosen to address environmental parameters known to limit habitat of salmonid fishes generally and are currently identified as limiting factors in the Creek. For instance, the annual fish habitat in the Creek may be limited by existing thermal regimes in the creek that are a consequence of the seasonally warm surface waters from Lake Whatcom. Maximizing the availability of seasonal thermal refugia for salmonids during periods of elevated stream temperatures would serve to reduce natural mortality or other sub-lethal effects adversely affecting salmonid life stages. Furthermore, the specific location of the rehabilitation has been chosen to maximize the potential for success. For instance, the WDFW indicates that the Cemetery Creek confluence and Whatcom Creek near Salmon Park are significant spawning areas. Enhancement of fish habitat in these areas is preferred, since there is known salmonid use and restoration potential that serves to achieve the overall goal of increased quality salmonid habitat. Once the projects are complete, fish utilization of the sites is expected to be high.

Performance Criteria and Monitoring

The project areas will be surveyed prior to construction, and detailed construction plans will be prepared. All construction activities will be monitored to ensure that the work is implemented appropriately and in accordance with permits. Fish surveys will be conducted following completion of the projects to monitor recovery and need for any mid-course corrections.

Benefits and Environmental Impacts

There are short- and long-term benefits from the restoration work proposed within Salmon Park and Cemetery Creek. In the short term, physical habitat improvements will provide cold-water rearing habitat in Cemetery Creek and high-flow refuge within Salmon Park and Cemetery Creek for juvenile and resident salmonids to improve survival of floods. In the long term, the restoration of natural stream channel processes within Salmon Park will improve habitat

complexity for both fish and wildlife. Intensive re-vegetation efforts will accelerate the development of a climax cedar wetland forest within Cemetery Creek and portions of Salmon Park.

The Salmon Park and Cemetery Creek projects are not anticipated to have any significant and deleterious environmental or socioeconomic impacts. Overall, the projects are expected to directly benefit fish, and provide collateral benefits to invertebrates, birds, terrestrial wildlife, water quality, vegetation, and recreation. Potential impacts from the project are summarized here.

- **Erosion and Sedimentation**—The Trustees expect short-term impacts to water quality (sedimentation) as a result of construction-related activities. These impacts will be minimized through careful design and appropriate construction practices, including seasonal construction windows and sediment control structures. These potential impacts will be addressed through the permit conditions for the project.
- **Endangered Species**—No significant adverse impacts are expected for endangered species. There are no endangered plants in the project area. The permit conditions and construction plans for the project will address protection measures for endangered salmon, including seasonal construction windows, rescue and relocation of juvenile fish prior dewatering areas, screening on pumps to prevent fish entrapment, erosion control measures, and spill containment for heavy equipment.
- **Wildlife Impacts**—No significant adverse impacts are expected for wildlife. Overall, wildlife are expected to benefit from the projects but wildlife activity may be temporarily disturbed during the construction phase of the project. If sensitive wildlife species are found during the project (e.g., nesting birds), the work may be modified or stopped to minimize impacts to wildlife.
- **Archaeology**—No known archaeological sites are on the lands proposed for the project. There is, however, the potential that construction work may unearth a site. The Trustees are in consultation with the Tribes and the Office of Archaeology and Historic Preservation to outline steps that would be taken to ensure that any sites discovered would remain undisturbed by the proposed actions (AR #139, 140).
- **Wetlands**—The proposed projects have the potential to impact wetlands near the confluence of Cemetery and Whatcom creeks. To reduce the potential for wetland impacts, the Trustees considered several alternative designs for the Salmon Park and Cemetery Creek projects (AR #119-122). A wetland delineation was also conducted for the proposed enhancement areas (AR #126). Based on the delineation and preliminary discussions with state and local regulatory officials, the project was further revised to minimize wetland impacts. The permit conditions and construction plans for the project will also mandate techniques to minimize

collateral impacts during the construction phase of the project, including salvage and re-use of native vegetation, minimization of vehicle and heavy equipment impacts, and reseeded of disturbed areas.

Evaluation

The projects have a high probability of success and the Trustees believe the additional habitat will, as they develop, compensate for the impacts to fisheries resulting from the Incident. The proposed activities will also provide multiple benefits for the natural resources along Whatcom and Cemetery creeks. The created habitats will take some time to reach full maturity, but should begin to provide habitat functions shortly after they are constructed.

5.2.3 Preferred Alternative: Soil Stabilization and Revegetation Actions

Project Description

During the emergency response phase of the Incident, the Company, the EPA, and the Trustees worked together to develop and implement a series of emergency restoration actions. The Trustees propose that the revegetation projects be completed, specifically completion of planting efforts near the break site and maintenance of the vegetation (Figure 32). The revegetation plan is intended to restore the area's terrestrial and riparian vegetation to pre-Incident or better condition. The plan involves:

- Completion of the planting of native tree seedling stock to quickly produce a closed canopy (Figure 31) and to remove or control weedy invasive species using a combination of chemical and mechanical methods (completed except for area around the water treatment facility);
- Give restoration credit to the Company for development of a watershed-wide invasive-plants hot-spot map and control strategy (AR #100) and implementation of this strategy in areas directly and indirectly impacted by the Incident (plan completed as part of emergency restoration; maintenance is ongoing);
- Give restoration credit to the Company for removal of hazardous trees and limbs injured by the Incident, for the purposes of protecting public safety and improving public access to the impacted areas (largely completed as part of emergency restoration; maintenance is ongoing); and
- Give restoration credit to the Company for stabilization of burned soils to prevent erosion and provide a stable and fertile soil for planting of replacement trees (completed, except for area around the water treatment facility).

Scaling Approach and Justification

Approximately 17% of the burned area, located on the floodplain terrace of the Creek downstream of Whatcom Falls Canyon, is dominated by invasive species, such as Himalayan blackberry, and has no tree canopy cover (AR #15, 100). These invasive-weed-dominated stands of shrubs and low-growing vegetation will be replaced with native vegetation and converted to mixed evergreen and deciduous forest canopy, increasing the quality of riparian habitat on this segment of the Creek to above pre-Incident conditions.

The Trustees have selected this project as a preferred alternative because it directly restores resources and services affected by the Incident. The overall scale of the project (in terms of number of trees planted) is based on the size of the burn area and the intensity of the replanting efforts. The Trustees determined that approximately 26 acres of vegetation was injured as a result of the Incident, and all of the burn areas have been targeted for replanting of native species and control of invasive species. Most of the affected areas have already been planted as part of the emergency restoration effort, but a few areas near the break site still need to be planted. Watering, thinning, and other follow-up maintenance activities are also ongoing in the replanted areas.

Other key factors in scaling the replanting effort were intensity of the planting effort (number of seedlings planted per square meter) and the age/size of the seedlings. The optimal planting density is a function of pre-Incident vegetation types, terrain, shade, slope, access, soil type, seedling size, and seedling species. Using these factors, the Trustees recommended a clumped planting pattern of mixed species, with an approximate density of 25 square feet per tree or 5.8 feet on center (AR #108). A total of eight species were planted. Conifers, including Western red cedar (*Thuja plicata*), Douglas fir (*Pseudotsuga menziesii*), Sitka spruce (*Picea sitchensis*), and Western hemlock (*Tsuga heterophylla*) accounted for 72% of the plantings. Deciduous trees accounted for the remaining trees, including big leaf maple (*Acer marcophyllum*), red alder (*Alnus rubra*), paper birch (*Betula papyrifera*), and cottonwood (*Populus balsamifera*) (AR #109).

The age/size of the seedlings is a factor in recovery of the forest canopy. Planting older and larger trees was considered as a means to accelerate recovery, but, for the reasons outlined in section 5.4, the Trustees chose to use the smaller seedlings.

Restoration Objectives

The overall goal of the emergency revegetation projects was to protect the burned areas from further injury and restore the area's terrestrial and riparian vegetation to pre-Incident or better condition. By restoring the vegetation lost in the fire, erosion was reduced, shade was created for the stream, and better habitats were available for fish, birds, and terrestrial species. The emergency restoration efforts also helped reduce the duration of the park closures and will help reduce the period of time that will elapse until the forest is re-established. While considerable progress was made during the emergency phase, completion of the plantings near the break site

and maintenance of the revegetation efforts will be necessary to ensure the recovery of functioning forest and riparian habitats.

Probability of Success

The probability of success for this revegetation project is high. The emergency work conducted to date has been successful and the same techniques and approaches will be used. No major implementation problems are anticipated. As part of the restoration approach, the Trustees have chosen factors such as age, size, species, and density to ensure the success of the restoration objectives.

Performance Criteria and Monitoring

An overview of the technical specifications for the project is included in the Emergency Restoration Plan prepared by the Company (AR #1). Those specifications cover the protocols for stabilization of soils and removal of non-native vegetation, including the species that will be removed and the areas of removal. Similar information is available for the planting of native vegetation. Long-term maintenance of the plantings and monitoring/removal of invasive-plant species would be provided through the maintenance fund to be managed by the City³⁸. (See Section 5.2.4)

Benefits and Environmental Impacts

Potential impacts from the project are summarized here:

- **Erosion**—The project has the potential to temporarily increase erosion in the watershed. Work near the stream will be conducted in a manner to limit erosion and control sedimentation. Foot and vehicle disturbance will be kept to a minimum. When non-native vegetation is removed, the areas will be rapidly replanted to ensure that native species will be able to thrive.
- **Endangered Species**—No adverse impacts are expected for endangered species. Endangered salmon will be protected through erosion control measures and will benefit from the shade and habitat provided by a healthy riparian zone.
- **Wildlife Impacts**—No adverse impacts are expected for wildlife. Overall, wildlife are expected to benefit from healthy native vegetation, but wildlife activity may be temporarily disturbed because of the presence of field workers. If sensitive wildlife species are found during the project (e.g., nesting birds), the work may be modified or stopped to minimize impacts to wildlife.
- **Archaeology**—No known archaeological sites are planned for treatment work is not expected to unearth any sites. The Trustees are in consultation with the Tribes and the Office of

³⁸ AR #141

Archaeology and Historic Preservation to outline steps that would be taken to ensure that any sites discovered would remain undisturbed by the proposed actions.

Evaluation

The Trustees find that the benefits of the proposed project far outweigh any negative impacts. The project will provide ecological services of the same types lost as a result of the Incident. The revegetation and non-native plant control efforts will help compensate for injuries sustained by riparian habitats and provide habitat for terrestrial wildlife and birds. As the vegetation matures, the plantings will provide shade, reduce erosion, and minimize sedimentation of the Creek. As a collateral benefit, the mature vegetation will provide recreational and aesthetic benefits for hikers, fishermen, and joggers that utilize the area.

5.2.4 Long-term Monitoring and Maintenance

Monitoring and maintenance are essential elements of any restoration project. Each of the proposed restoration projects will have a monitoring and maintenance element to document recovery, evaluate long-term performance, and provide for routine repairs and upkeep. In addition, other restoration projects that develop over time will also have monitoring and maintenance components. The proposed monitoring actions will help to document the recovery of the Creek and the success of the individual projects. The monitoring will also help to detect problems at an early stage, when repairs and adjustments may yet be relatively simple and inexpensive. Similarly, routine maintenance of the project sites will help prevent small problems from growing. The Trustees believe that these maintenance and monitoring efforts will help to advance the effectiveness of the overall restoration plan and help ensure public health, safety, and enjoyment of the restoration sites.

Rather than attaching a small fund to each project, the Trustees and the Company propose that a \$500,000 fund be designated to cover all long-term monitoring and maintenance actions.³⁹

The primary goals of the monitoring and maintenance activities are to ensure that the proposed habitat projects function as designed and are maintained and repaired as necessary. In the restoration ecology and wetland engineering literature, this process of monitoring and mid-course adjustment is known as adaptive management.⁴⁰ Monitoring is also important for

³⁹ A number of monitoring actions are routinely attached to permit approvals for projects conducting work in wetlands and streams. Monitoring that is required for compliance with the permits for the Cemetery Creek and Salmon Park projects, or other proposed construction activities, are directly covered under those projects. These compliance conditions are intended to assure the regulatory agencies that the project will be constructed as planned and to minimize construction-related environmental impacts. For example, compliance monitoring and maintenance may include: use and maintenance of temporary erosion controls (e.g., silt fences); use and maintenance of fish screens to exclude fish from the project area; testing of fill materials to demonstrate they do not contain contaminants; monitoring of water quality and turbidity during construction; cleanup and restoration of staging and parking areas; watering and monitoring to ensure survival of plantings; and submission of an As-Built Report after project completion.

⁴⁰ <http://www.epa.gov/owow/wetlands/restore/principles.html#17> and <http://www.epa.gov/owow/wetlands/restore/>.

measuring success, informing the local public and other interested parties regarding the progress of the projects, and improving the understanding of restoration science and design of future restoration projects.⁴¹

The proposed activities will use commonly accepted monitoring protocols and typical maintenance practices. The maintenance and monitoring projects are not anticipated to have any deleterious impacts. Unless a need for major repairs or mid-course corrections is identified, the monitoring and maintenance actions are anticipated to cause only minimal disturbance to the restoration sites—primarily through foot traffic of the scientific and maintenance crews. The occasional removal of hazardous trees may require use of trucks and other equipment. Maintenance crews will attempt to minimize impacts to sensitive areas when such upkeep is required.

The specific details of the monitoring and maintenance projects (i.e., primary and reference locations, frequency, sample size, etc.) will depend on specific project objectives, whether changes to this proposed plan become necessary, and the completion of the detailed design documents for each of the plan elements. The Trustees anticipate that the maintenance fund will be used for the following actions:

Monitoring

The main objectives of monitoring are to ensure that the habitat restoration projects function as designed and to identify corrective actions to ensure that these projects continue to function over time. Monitoring will be used to assess long-term effectiveness of the restoration and to determine the need for corrective actions. It is anticipated that a variety of biological, physical, and chemical parameters will be monitored to meet these objectives.

Biological Parameters

- Vegetation surveys to determine species composition, density, plant health, mortality, percentage cover, canopy closure percentage, presence of invasive species, and herbivore damage (e.g., girdling by beaver) in impact and restoration areas;
- Fish community surveys to assess use of the stream and restoration sites by anadromous and resident fish. Such monitoring will include surveys of fish spawning areas (e.g. redd and carcass surveys) and use of the restoration areas by adult and juvenile fish;
- Macroinvertebrate community surveys to assist our understanding of the recovery of the stream ecology, habitat quality, and also to serve as indicators of the quality and quantity of food resources available to salmon, trout, and other aquatic animals; and

⁴¹ Periodic monitoring and maintenance reports will be prepared for the various projects.

- Riparian wildlife/terrestrial community surveys to document the presence, relative abundance, and habitat utilization of birds and terrestrial wildlife.

Physical and Chemical Parameters

- Riparian and stream habitat surveys to assess the persistence and function of instream wood structures (e.g. large woody debris), pool/riffle ratios, and channel characteristics;
- Surveys to identify the presence of dead and dying trees in the impact zone that may pose a safety hazard to the public;
- Erosion surveys to identify problem areas within the burn zone and restoration sites; and
- Water quality monitoring in the creek and restoration sites, which may include parameters such as temperature, turbidity, pH, dissolved oxygen, etc.

Photodocumentation

- Permanent photo points will be located at each restoration site to document seasonal and annual changes.

Maintenance

Results from the monitoring surveys will be used to help identify problem areas so that corrective actions can be taken to ensure recovery of the creek and riparian zone, and restoration projects function as intended. These actions include maintenance of:

Riparian Restoration Areas

- Riparian plantings throughout the Whatcom Creek corridor will require maintenance until they are established;
- Typical maintenance activities include removal of dead material, replanting, removal of invasive species, and protection from small mammal predation.

Stream Restoration Sites

- Habitat modifications and log structures placed in Whatcom Creek and at the Salmon Park and Cemetery Creek restoration sites to create habitat, trap sediment, and influence stream dynamics will be maintained to ensure their continued function for the intended purposes;
- Other structures such as ponds or connecting channels will be maintained to ensure they continue to function as designed.

Removal of Hazard Trees

- Removal of dead trees in the impact area to reduce safety hazards to the public.

Erosion Control

- Riparian areas impacted by the fire may need ongoing erosion control (e.g., mulching, plantings, cribbing) during recovery.

5.3 Non-Preferred Alternatives

The Trustees considered the following restoration projects to replace ecological and human-service losses resulting from the Incident. All of the non-preferred projects were expected to be beneficial, but the Trustees rejected these projects because better alternatives existed or because the alternative did not meet one or more of the evaluation criteria discussed above.

No Action—The Trustees considered the no-action alternative but rejected this option as the sole alternative because although natural recovery would occur over varying time scales for the various injured resources, the interim losses suffered would not be compensated under the no-action alternative.

Interpretive Center—This proposal involved creating an interpretive environmental center. The Trustees agree with many of the goals of this project but have determined that other proposed projects would more effectively restore fish and wildlife injuries and losses resulting from the Incident. The Trustees do intend to incorporate educational features and opportunities, where feasible, into the project designs. For example, the Salmon Park and Cemetery Creek projects will be designed to provide access, viewing, and recreational, and educational opportunities for the public by integrating trails, stream overlooks, and educational kiosks and markers.

Carcass Planting—Distributing salmonid carcasses in the Creek was considered as a strategy to restore the nutrient base and macroinvertebrate communities in the stream (AR #111-113). These nutrients and macroinvertebrates would, in turn, provide an increased food source for juvenile salmonids. Although this was a viable alternative, the return of many chum salmon to the Creek in the late summer and fall of 1999 provided a natural source of nutrients. Nutrients, in general, are not thought to be a limiting factor to creek restoration. Therefore, this proposal was determined to be unnecessary.

Additional Channel Habitat Modifications and Woody Debris in Whatcom Creek These options involve creation or enhancement of instream features such as pools, gravel bars, riffles, glides, and runs (AR #114, 123, 134, 136). Most of these actions were conducted during the emergency phase of the Incident to reposition gravel that was disturbed during the streambed agitation work and replace woody debris that was removed (AR #1). Further channel habitat modifications in the Creek are not preferred because better restoration alternatives are available and because the necessary heavy machinery in the streambed has a potential to set back the recovery process. The Cemetery Creek and Salmon Park restoration projects identified in the preferred alternative involve modifications of existing or historical stream channels and placement of woody debris to enhance fish habitat. These projects are discussed in Section 5.2.2.

Debris Removal—The purpose of this project was to remove garbage and debris from the Creek to benefit habitat and aesthetic values. The Trustees have determined that much of the garbage was removed during the emergency response phase of the Incident and a specific restoration project focused on debris removal does not appear to be necessary at this time. If debris does become an issue, the proposed maintenance fund could be utilized to address the problem. (See Section 5.2.4.)

Fish Passage—This project involved creating upstream passage for anadromous salmonids at Middle Falls, thereby increasing available spawning habitat and potentially greater fish production. The proposal involved creating a logjam below the falls to form a step pool. This would reduce the height of the falls to a level that salmon could jump. The Trustees have rejected this specific alternative because better restoration alternatives are available. The Trustees had concerns about the technical feasibility and life span of the step pool (AR #114, 134), competition with resident fish above the falls (AR #25, 115, 135), and potential aesthetic impacts to the falls.

Sewer Line Upgrades—This option involved upgrading the sewer line on the lower section of the Creek to make fish passage easier. Although relocation or removal of the sewer line from its current location (where it acts as a “check-dam”) may allow the stream to function naturally for a certain distance upstream, the improvements in habitat would be minor relative to the costs, environmental disturbance, and engineering effort necessary to relocate the sewer line. Furthermore, fish are able to pass the sewer line in its current configuration. Therefore, the Trustees have rejected this alternative.

Temperature Modifications—The Trustees have determined that water temperature is one of the limiting factors for salmonid productivity in the Creek (AR #15). Higher-than-optimal summer water temperatures are stressful (AR #26) and result in reduced growth and survival (Figure 27). Prevailing water temperatures are partly due to natural causes (the outlet of Lake Whatcom occurs in a warm, shallow bay and surface water temperatures routinely reach 20°C or more during summer months) and partly due to human causes (surface spillway, reduced summer flows due to regional water use, and loss of riparian forests along the lake and creek). Several temperature modification alternatives were evaluated, including searching for cold water from deep sections of Lake Whatcom, managing spilled water to reduce water temperatures, and adding groundwater flows to the Creek (AR #15). All of these alternatives have potential merit but were rejected because of volume of water necessary, technical feasibility, and concerns about sustainability.

Off-site Land Acquisition—The Trustees considered both on-site and off-site land acquisitions to help compensate for the lost ecological and human-use services (AR #15). The goals of the land acquisition are to prevent future development and promote ecological and recreational uses. A specific off-site acquisition project proposed by the Company was rejected by the Trustees because the land was already protected by conservation easements (AR #82, 83). Acquiring

lands in Whatcom Creek watershed was a priority because on-site acquisition would directly compensate for the human uses, while off-site acquisition would potentially benefit a different set of users. Furthermore, the relative scarcity of public lands within the urban boundary, as well as developmental pressures, make lands along the Creek much more valuable. Off-site acquisition was not necessary because on-site parcels of land were available.

Alternative Designs for Cemetery Creek and Salmon Park—At the request of the Trustees, the Company and its contractor, Inter-Fluve, Inc., developed a series of conceptual plans for the creation of fisheries habitats at the Cemetery Creek and Salmon Park sites (AR #118-122). These alternatives varied in the overall size of the projects, the locations of the pools and stream channels, amounts of woody debris, and the preservation of trees on the site. These various alternatives were reviewed for potential benefits and environmental impacts, as well as construction feasibility and regulatory and permitting concerns. These alternatives were reviewed by the Trustees and modified to increase the fisheries benefits and minimize the impacts to existing habitats. This iterative review and modification process resulted in the current proposed plan in Section 5.2.2 .

Stocking—Following the Incident, the recreational fishery was closed, and it remains closed to allow recovery of sustainable populations of resident and anadromous fish stocks in the lower basin. The Trustees considered stocking sterile trout to help open a season as quickly as possible. There are, however, significant concerns regarding competition for food with surviving resident and anadromous fish stocks (AR #115, 135). Therefore, the Trustees have rejected this alternative.

Whatcom Falls Hatchery Upgrades—The Trustees considered improvements to the hatchery in the Park as compensation for the lost fishing opportunities in the Creek. Warm water temperatures currently preclude year-round hatchery operations. As a result, the hatchery is prevented from rearing certain species and cannot raise fish to recreationally harvested sizes. The alternative involved trying to find a source of colder water so that the hatchery could operate through the summer months. These fish would then be available for recreational stocking of lakes in the area. The Trustees rejected this proposal because of the costs and feasibility associated with providing cooler water and the broader concerns over stocking of hatchery-reared fish (AR #115, 127).

Planting Large Trees—The focus of forest revegetation efforts to date has been the planting of seedlings. The Trustees evaluated whether planting older and larger trees would enhance the recovery rate of the forest canopy. The Trustees determined that while the technology exists to move large (up to 50-foot) trees, the costs and maintenance needs are high, survival of the trees can be low, and their growth rates may be retarded for several years. Smaller trees have a high survival rate and have inherently more rapid growth; after overcoming the temporary stress of transplantation, small trees quickly resume their growth. A smaller tree will recover sooner and may actually be taller than a larger transplanted tree ten years later (AR #116). Furthermore,

planting large trees would require temporary roads and heavy equipment in areas that are sensitive to disturbance. Smaller trees can be hand-carried and planted without the use of heavy equipment. As a result, the Trustees rejected the concept of widespread planting of large trees, but may selectively plant 5- to 10-foot trees where access is feasible (e.g., near access roads).

Gabion Removal—Gabion (rock-filled wire basket) removal would provide a flood benefit; however, it is not directly related to the injury and difficult to scale. In addition, gabions are located downstream of the burn and not in the area affected most by the Incident. Although habitat improvements can be made following gabion removal, the Trustees believe that other projects provide greater ecological and recreational benefits.

Automobile Use Reduction—The suggestion to fund a program to pay people who work and commute to downtown Bellingham to ride their bikes, walk, or take the bus instead of driving has the potential of reducing air and water pollution within the Whatcom Creek watershed and Bellingham as a whole. This project was proposed as part of the Lake Whatcom/Whatcom Creek residential pledge project (AR #117). These benefits, although real, are extremely difficult to quantify and very difficult to monitor for success.

5.4 Restoration Summary

A total of thirty-four specific restoration alternatives and/or restoration locations were identified. These restoration alternatives were evaluated for restoration location and site characteristics, restoration description, overall goal of restoration, objectives, implementation issues, economic feasibility issues, and methods of monitoring and judgment of success.

Table 3 summarizes the injuries and preferred restoration alternatives for the Incident.

Table 3: Injuries and preferred restoration alternatives

Preferred Alternative	Injury Categories	Description and Benefits
Completion of planting and invasive- species control	Vegetation, Wildlife, Salmonids, Water Quality, Recreation	The vegetation projects implemented during Emergency Restoration Phase will be completed. The burn zone was replanted and areas dominated by invasive vegetation prior to spill were restored using native vegetation. The planting of trees and removal of invasive vegetation will have multiple benefits to the park, terrestrial wildlife, and help to protect water quality in Whatcom Creek.
Acceptance of 4-acre parcel along Whatcom Creek near confluence with Cemetery Creek	Vegetation, Wildlife, Salmonids, Water Quality, Recreation	Acceptance of the transfer of this parcel will help protect Whatcom Creek. This parcel was selected for acquisition for protection from development, connectivity of wildlife habitat, parks and greenways, and to leverage future restoration projects. Restoration projects conducted on this site will be specifically designed to benefit fish, wildlife and riparian habitat. Trails along the edge of the parcel will provide recreational benefits.
Acceptance of 9.5-acre parcel along Whatcom Creek at Woburn Street	Vegetation, Wildlife, Salmonids, Water Quality, Recreation	Acceptance of the transfer of this parcel will expand Whatcom Falls Park. The additional land will provide increased access to park trails and creek for public use such as hiking, nature watching, fishing. The acquisition of the riparian area will preclude development and protect an important spawning and rearing area for salmonids. The acquisition will also benefit water quality, vegetation, and wildlife.
Recreational Improvements to 9.5-acre parcel	Recreation	Construction of a small parking lot and restrooms facility. These improvements will benefit recreational use of the park, but will use an existing access road and be designed to minimize impacts on fish and wildlife habitat.
Salmon Park Project	Fish, Aquatic Biota, Recreation, Wildlife, Water Quality	Construction of off-channel salmonid habitat near Racine Street will improve winter refuge habitat for juvenile salmonids and provide benefits to aquatic and terrestrial wildlife. Creation of backwater channel will also benefit public uses such as nature watching and tribal and recreational fisheries.
Cemetery Creek Project	Fish, Aquatic Biota, Recreation, Wildlife, Water Quality	Construction of pools, wetlands and salmonid rearing habitat on lower Cemetery Creek will benefit salmon and also provide public uses such as nature watching and tribal and recreational fisheries.
Monitoring and Maintenance	All	Funding for long-term monitoring of Whatcom Creek and restoration projects. Funding for maintenance of the restoration projects and parcels injured by the Incident

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